

DOCUMENT RESUME

ED 125 780

PS 008 688

AUTHOR Franz, W. K.; And Others
TITLE Individual Differences and Auditory Conditioning in Neonates.
PUB DATE Apr 76
NOTE 14p.; Paper presented at the Biennial Southeastern Conference on Human Development (14th, Nashville, Tennessee, April 15-17, 1976)
EDRS PRICE MF-\$0.83 HC-\$1.67 Plus Postage.
DESCRIPTORS Auditory Perception; *Aural Stimuli; Behavior Rating Scales; Conditioning; *Heart Rate; *Individual Differences; *Infants; *Learning; *Research
IDENTIFIERS Brazelton Neonatal Behavioral Assessment Scale; *Neonates

ABSTRACT

The purposes of this study are (1) to analyze learning ability in newborns using heart rate responses to auditory temporal conditioning and (2) to correlate these with measures on the Brazelton Neonatal Behavioral Assessment Scale. Twenty normal neonates were tested using the Brazelton Scale on the third day of life. They were also given a learning task, which consisted of a temporal conditioning paradigm with a slow-rise, 75 db tone played for 5 seconds every 25 seconds, 10 times. Responses to the tones were measured by instantaneous, beat-to-beat heart rate, and learning was measured by mean heart rate change and slope computed on the period following the last stimulus when a tone would have been expected (response to the test trial). Results indicate that the 3-day-old baby whose heart rate indicates response to a temporal learning situation is older in gestational age than babies who do not indicate response, and is able to control his psychological state, but shows signs of neurological immaturity. He tends to be less responsive in situations of human closeness including orienting, alertness and cuddliness as measured by the Brazelton Scale. (Author/SB)

* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *

ED125780

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

Individual Differences and Auditory
Conditioning in Neonates

Franz, W.K., Self, P.A., Franz, G.N.

West Virginia University

PS 008688

Presented at the Fourth Biennial
Southeastern Conference on
Human Development,
Nashville, Tennessee,
April, 1976

Individual Differences and Auditory Conditioning in Neonates

Franz, W.K., Self, P.A., Franz, G.N.
West Virginia University

Although there are still claims to the effect that newborn babies cannot learn (Sameroff, 1971), a number of investigators have used the temporal conditioning paradigm to demonstrate learning in three-day-old babies (Clifton, 1971; Lipsitt & Ambrose, 1967; Stamps, 1974). However, no one has attempted to analyze individual responses to learning situations. Such research would give us some indication of the range of individual variability at the beginning of life. The purpose of this study is to analyze learning ability in newborns using heart rate responses to auditory temporal conditioning and then to correlate these with measures on the Brazelton Neonatal Behavioral Assessment Scale (Brazelton, 1973). Such a study will give evidence for individual differences in newborn learning ability, if they exist; and, in addition, we should obtain some information on the nature of the psychological meaningfulness of the infants' learning behavior.

Method

Twenty three-day-old babies (ten boys and ten girls) were selected from the newborn nursery at West Virginia University Hospital. Only those infants were included who were normal, healthy and full-term. All testing was done in a laboratory adjacent to the nursery. On the third day after birth, the Brazelton Scale was administered by a trained tester. The learning measure was administered the evening of the same day by another tester, who was unfamiliar with the results of the Brazelton Scale.

The learning task consisted of a temporal conditioning paradigm with a slow-rise, 75 db tone played for five seconds every 25 seconds, ten times. (See slide 1.) The test trial was defined as the 30-seconds following the last stimulus trial when the 11th stimulus would have been expected. Thus, the violation of expectancy, results in orienting, or heartrate deceleration.

The particular tone was chosen because it was most apt to elicit heartrate decelerations in the newborn baby (Hatton, Berg & Graham, 1970; Jackson, Kantowitz & Graham, 1971). All sessions occurred approximately one hour to 30 minutes prior to the 10 p.m. feeding when the babies were in a quiet-awake state, as defined by Brackbill and Fitzgerald (1969). Heartrate data obtained prior to eating and when the child is in a quiet-awake state are most apt to produce heartrate decelerations (Kearsley, 1973; Pomerleau-Malcuit & Clifton, 1971). The electrocardiogram was transmitted using telemetry equipment. It was recorded for 20 seconds prior to the onset of the learning task, in order to measure pretrial, resting, heartrate variability. The learning session lasted for 5 1/2 minutes, the maximum time that the majority of subjects could be expected to maintain an alert state as shown by Berg, Adkinson, and Strock (1973).

All data were stored on magnetic tape and then fed into a PDP-11 computer, which accumulated elapsed time, computed the interval between two succeeding heart beat pulses in milliseconds (the beat-to-beat interval), and computed the reciprocal of each interval in units of heart beat per minute (instantaneous heart rate). This information was transferred onto IBM compatible digital tape for processing by the IBM 360 computer system. The Cardivar program for analysis of cardiac data, as developed by Wilson (1974) and Wilson and Scott (1970) was modified for use with the SAS Program package.

The heart rate data were analyzed using three periods of time associated with each trial: (See slide 2.) the anticipatory response period (2 1/2 seconds prior to onset of the sound stimulus), the response to onset (2 1/2 seconds following onset of the sound stimulus), the response to offset (2 1/2 seconds following offset of the sound stimulus). The test trial was analyzed using two measures: (1) mean heartrate change (between anticipatory

and onset periods) and (2) slope of the regression line for the onset period of the test trial. Two maturational measures, weight and gestational age, as estimated by the physician, were also obtained. The range for gestational age was from 38 - 43 weeks. These four measures were correlated with all measures on the Brazelton Neonatal Behavioral Assessment Scale.

Results

There was a great deal of individual variability among the 20 subjects. For instance, pretrial heartrate variability ranged from 3.77 to 98.95, the test trial from -14.35 bpm to 21.08 bpm. A great deal of individual variability is already apparent in the learning responses of three-day-old infants.

Graham and Clifton (1966) have established that heartrate decelerations are a measure of orienting, in the presence of which learning should occur. Therefore, this directional response was correlated with all items on the Brazelton Scale, as well as the two maturational measures. (See slide 3.)

A decreasing slope for the test trial was correlated with skin color lability, as measured by the Brazelton Scale. Mean heartrate decreases were correlated with tremulousness and self-quieting. Thus, the largest heartrate decreases occurred in those babies with the ability to control their own psychological state (self quieting) and neurological functions, as measured by lability of skin color and tremulousness on the Brazelton Scale. It should be noted that none of the infants observed was judged to be abnormal in his neurological responses; that is, the variability was within normal limits.

Graham and Jackson (1970) have suggested that heartrate decelerations do not have the same psychological significance in infants as they do in older subjects. Therefore, the directional signs were removed and the correlations run again using magnitude only. (See slide 3.) The magnitude of the slope of the test trial correlated with estimated gestational age. Thus, rapid, intense heartrate responses to external stimuli seem to require a

relatively high level of maturation. This finding suggests the possibility that heartrate response systems are a relatively poor measurement index for immature subjects. Magnitude of mean change for the test trial was negatively correlated with the orienting, alertness, and cuddliness measures on the Brazelton Scale. Thus, the alert, cuddly baby does not appear to respond strongly to irrelevant, auditory temporal stimuli either by blocking (HR increase) or by orienting (HR decrease) to the stimulus.

Discussion

This is a surprising finding, since we tend to assume that alertness is a prerequisite for learning. It might best be explained by looking at the Brazelton Scale intercorrelations. (See slide 4.) As you can see from the intercorrelation table, the orienting, alertness, and cuddliness items tend to be intercorrelated. At the same time they tend to be negatively correlated with the measures representing state and response control, such as peak of excitement, irritability, and tremulousness. For these subjects, peak of excitement, rapidity of build-up, irritability, lability of skin color and self-quieting show a tendency to be intercorrelated. Thus, two factors tend to emerge: (1) alertness and (2) reactivity, which are not related to each other. This is similar to factor patterns found for the Brazelton Scale in other studies (Bakow, Sameroff, Kelly & Zax, 1973; Morowitz, Aleksandrowicz, Ashton, Tims, McClusky, Culp & Gallas, 1973). Thus, the more alert and responsive the baby, the greater the control of his state. We know that newborn babies are particularly constructed to respond to social stimuli, and they orient, in particular, to human verbalizations (Eisenberg, 1970; Friedlander, 1970). Possibly, the more alert and well-controlled infants are those who will respond to social stimuli; and the irrelevant learning paradigms are simply ignored. As Worden has stated in his article on auditory habituation (1973), "A primary task in adaptation is to respond appropriately to stimuli that are

significant for the survival of the individual or the species. Since many stimuli impinge upon the organism at a given moment, to refrain from responding to insignificant stimuli is a necessary aspect of responding to significant stimuli." I would suggest that for the newborn baby, the significant stimuli are the social ones. It is possible that most learning occurs in the context of interpersonal relationships which are most important for survival and growth. Perhaps research into learning skills in newborns should be attempted in the context of the interpersonal learning situation and not in an irrelevant laboratory situation.

However, this study does demonstrate an instance in which newborn babies are capable of responding with heartrate decelerations in a learning situation. Those who do respond seem to be the ones, who are capable of controlling their reactive patterns, but not necessarily their attentional mechanisms. It is possible that in the newborn baby, these two systems are not yet coordinated, as they will be later in life. Although alertness and reaction control are associated in the same individual, they are not necessarily used together in the service of learning. However, this data seems to suggest that decelerations and not accelerations are indicative of learning in a temporal conditioning paradigm. Possibly research into social learning in the newborn baby will help to explicate some of these problems.

REFERENCES

- Bakow, H., Sameroff, A. J., Kelly, P., & Zax, M. Relation between newborn and mother-child interactions at four months. Presented at the Society for Research in Child Development, Philadelphia, 1973.
- Berg, K. M., Adkinson, C. D., & Strock, B. D. Duration and frequency of periods of alertness in neonates. Developmental Psychology, 1973, 9, 434.
- Brackbill, Y., & Fitzgerald, H. E. Development of the sensory analyzers during infancy. In H. W. Reese & L. P. Lipsitt (Eds.), Advances in Child Development and Behavior, Vol. 4. New York: Academic Press, 1969.
- Brazelton, T. B. Neonatal Behavior Assessment Scale. Clinics in Developmental Medicine. London: William Hememann Medical Books, Ltd., 1973.
- Clifton, R. K. Heart Rate conditioning in the newborn infant. Paper presented at the annual meeting of the Society for Psychophysiological Research, St. Louis, 1971.
- Eisenberg, R. B. The organization of auditory behavior. Journal of Speech and Hearing Research, 1970, 13, 461-464.
- Friedlander, B. Z. Receptive language development in infancy: Issues and problems. Merrill-Palmer Quarterly of Behavior and Development, 1970, 16, 7-51.
- Graham, F. K., & Clifton, R. K. Heart rate change as a component of the orienting response. Psychological Bulletin, 1966, 65, 305-320.
- Graham, F. K., & Jackson, J. C. Arousal systems and infant heart rate responses. In L. P. Lipsitt & H. W. Reese (Eds.), Advances in Child Development and Behavior, Vol. 5. New York: Academic Press, 1970.
- Hatton, H. M., Berg, W. K., & Graham, F. K. Effects of acoustic rise time on heart rate response. Psychonomic Science, 1970, 19, 101-103.
- Horowitz, F. D., Aleksandrowicz, M., Ashton, L. J., Tims, S., McClusky, K., Culp, R., & Gallas, H. American and Uruguayan Infants: Reliabilities, maternal drug histories and population differences using the Brazelton Scale. Paper presented at the Society for Research in Child Development, Philadelphia, 1973.
- Jackson, J. C., Kantowitz, S. R., & Graham, F. K. Can newborns show cardiac orienting? Child Development, 1971, 42, 107-121.
- Kearsley, R. B. The newborns response to auditory stimulation: A demonstration of orienting and defensive behavior. Child Development, 1973, 44, 582-590.
- Lipsitt, L. P., & Ambrose, J. A. A preliminary report of temporal conditioning to three types of neonatal stimulation. Paper presented at the Society for Research in Child Development, New York, 1967.
- Pomerleau-Malcuit, A., & Clifton, R. K. Neonatal heart rate response to tectile, auditory, and vestibular stimulation in different states. Child Development, 1973, 44, 485-496.

Sameroff, A. J. Can conditioned responses be established in the newborn infant: 1971? Developmental Psychology, 1971, 5, 1-12.

Stamps, L. E. Temporal heart rate conditioning in newborn infants. Unpublished doctoral dissertation, West Virginia University, 1974.

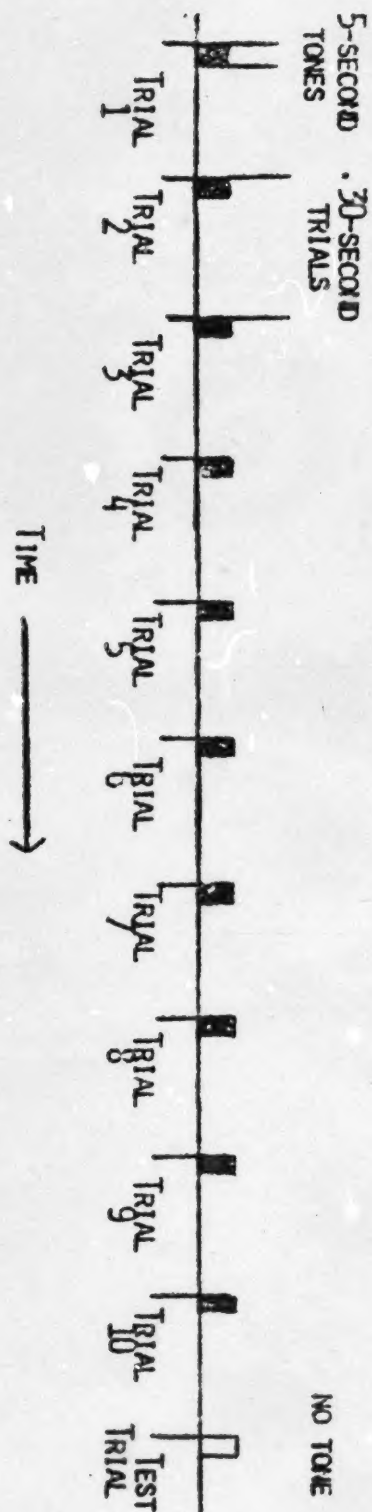
Wilson, R. S. Cardivar: The Statistical Analysis of HR Data. Psychophysiology, 1974, 11 (1), 76-85.

Wilson, R. S., & Scott, K. F. Computer programs for autonomic research. Behavioral Science, 1970, 15, 380-385.

Worden, F. G. Auditory habituation. In H.V.S. Peeke and J. H. Michael (Eds.) Habituation, Vol. II. Physiological Substrates. New York: Academic Press, 1973.

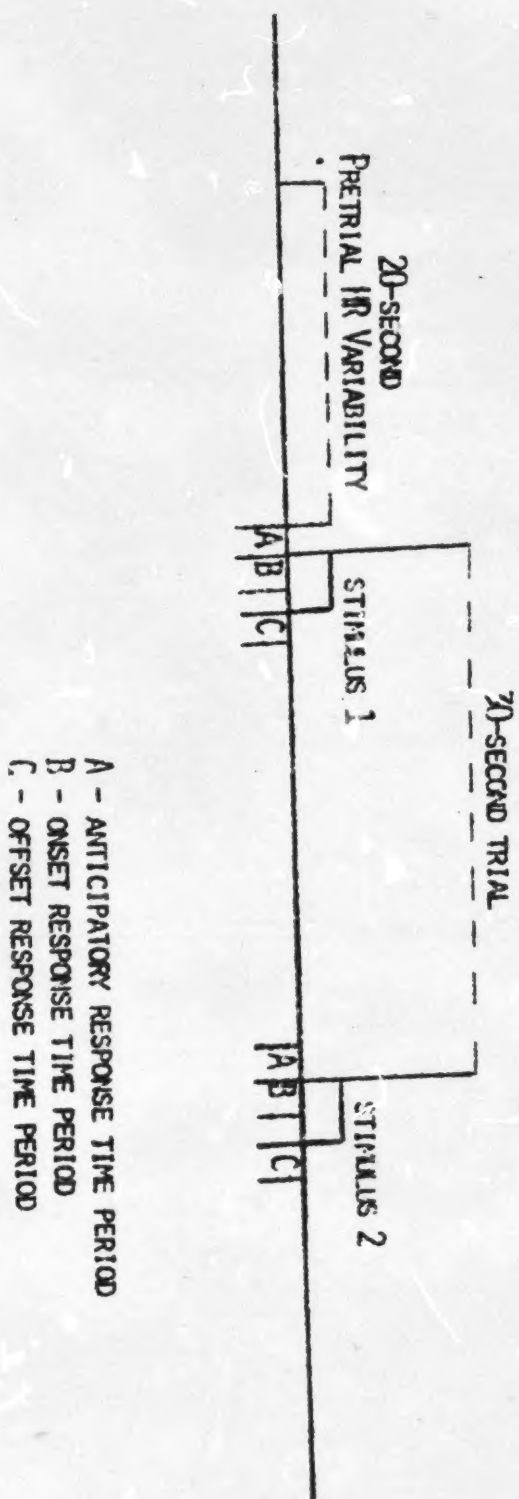
SLIDE 1

EXPERIMENTAL DESIGN FOR TEMPORAL CONDITIONING



SLIDE 2

DATA ANALYSIS - RESPONSE TIME PERIODS



SLIDE 3

SIGNIFICANT CORRELATIONS
DIRECTIONAL HEART RATE RESPONSE

	SLOPE OF TEST TRIAL	MEAN CHANGE OF TEST TRIAL
<u>BRAZELTON ITEMS</u>		
TREMULOUSNESS		- .56 **
LABILITY OF SKIN COLOR	.71 **	
SELF-QUIETING		- .50 *

* $p < .05$

** $p < .01$

SLIDE 4

SIGNIFICANT CORRELATIONS
MAGNITUDE OF HEART RATE RESPONSE

SLOPE OF TEST TRIAL MEAN CHANGE OF TEST TRIAL

BRAZELTON ITEMS

ORIENTATION
INANIMATE VISUAL

- .65 **

ORIENTATION
ANIMATE VISUAL

- .43 *

ORIENTATION
ANIMATE AUDITORY

- .47 *

ORIENTATION
ANIMATE VISUAL
AND AUDITORY

- .72 **

ALERTNESS

- .74 **

CUDDLINESS

- .57 **

MATURATION: AGE

.44 *

* $P < .05$

** $P < .01$

SLIDE 5

BRAZELTON SCALE ITEM INTERCORRELATIONS

BRAZELTON ITEMS	5	6	7	8	9	10	14	17	18	19	20	21	23	25
5 - ORIENTATION INANIMATE VISUAL														
6 - ORIENTATION INANIMATE AUDITORY	.52*													
7 - ORIENTATION ANIMATE VISUAL	.68**	.56**												
8 - ORIENTATION ANIMATE AUDITORY	.53*	.30**	.56**											
9 - ORIENTATION ANIMATE VISUAL AND AUDITORY	.83**	.75**	.70**	.82**										
10 - ALERTNESS	.81**	.66**	.61*	.78**	.85**									
14 - CUDLINESS	.46*			.50*	.48*									
17 - PEAK OF EXCITEMENT	-.55**	-.56**		-.51**	-.54**									
18 - RAPIDITY OF BUILDUP														
19 - IRRITABILITY	-.55**	-.43*	-.73*	-.56**	-.58**	-.66**	-.44*	.71**						
20 - ACTIVITY														
21 - TREMULOUSNESS														
23 - LABILITY OF SKIN COLOR														
25 - SELF QUIETING														

* $p < .05$ ** $p < .01$